APPENDIX G

Paleontologic Resources Technical Report
City of La Quinta General Plan 2010 Update

Prepared by

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August 12, 2010

PALEONTOLOGIC RESOURCES TECHNICAL REPORT
CITY OF LA QUINTA GENERAL PLAN
(2010 UPDATE)

For Submittal to:

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CRM TECH Contract No. 2429P
Approximately 48 Square Miles; T5-7S R6-8E, San Bernardino Base Meridian
USGS Indio, La Quinta, Martinez Mountain, and Valerie, Calif., 7.5' (1:24,000) Quadrangles

EXECUTIVE SUMMARY

Between March and August, 2010, CRM TECH performed a paleontological resources overview study on an approximately 37-square-mile area in and around the City of La Quinta, Riverside County, California. The subject of the study is the planning area for the City's general plan, including the current city limits as well as the city's sphere of influence. It measures approximately 10.5 miles along the north-south axis and 8 miles along the east-west axis, extending from the foothills of the Santa Rosa Mountains to the heart of the Coachella Valley. It consists of various sections in T5S R6E, T5S R7E, T6S R6E, T6S R7E, T6S R8E, and T7S R7E, San Bernardino Base Meridian, as depicted in the USGS Indio, La Quinta, Martinez Mountain, and Valerie, Calif., 7.5' quadrangles.

As part of the environmental overview for the general plan, the purpose of this study is to provide the City of La Quinta with the necessary information and analysis to facilitate paleontological resources considerations in the planning process and in formulating municipal policies. The study is based on portions of an existing Paleontologic Resources Mitigation Plan prepared for the City of La Quinta General Plan in 1999, recent paleontologic records searches at the San Bernardino County Museum and the Natural History Museum of Los Angeles County, a systematic review of pertinent paleontologic and geologic literature, and field observations in the planning area.

This report is intended to provide a basic understanding of the importance of paleontologic resources and the types of fossil remains that may be encountered during future development in the City of La Quinta, and present a general paleontologic sensitivity assessment of the planning area. It also offers a research-oriented framework and logistical guidelines that will facilitate the appropriate treatment of scientifically significant paleontologic resources when they are discovered. The logistics, procedures, and methods outlined herein ensure complies with the National Environmental Policy Act of 1969 (NEPA) and the California Environmental Quality Act of 1970 (CEQA). It is not the intent of this document to present a comprehensive list of all paleontologic localities or a discussion of all significant taxa that have been found in the planning area. A full treatment of all paleontologic localities and taxa pertaining to an area should be prepared in future paleontologic studies conducted as a part of environmental review process for specific projects.

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BACKGROUND

DEFINITIONS

The term "paleontologic resources" refers to fossil remains left behind from plants and animals, both vertebrate and invertebrate. The following definitions are presented to establish a necessary baseline for the subsequent discussion.

- Fossil: Any remains, trace, or imprint of a plant or animal that has been preserved in the earth's crust since some past geologic time (Bates and Jackson 1980:243).
- Paleontology: The study of life in past geologic time based on fossil plants and animals. It includes phylogeny, the study of relationships between past species and existing

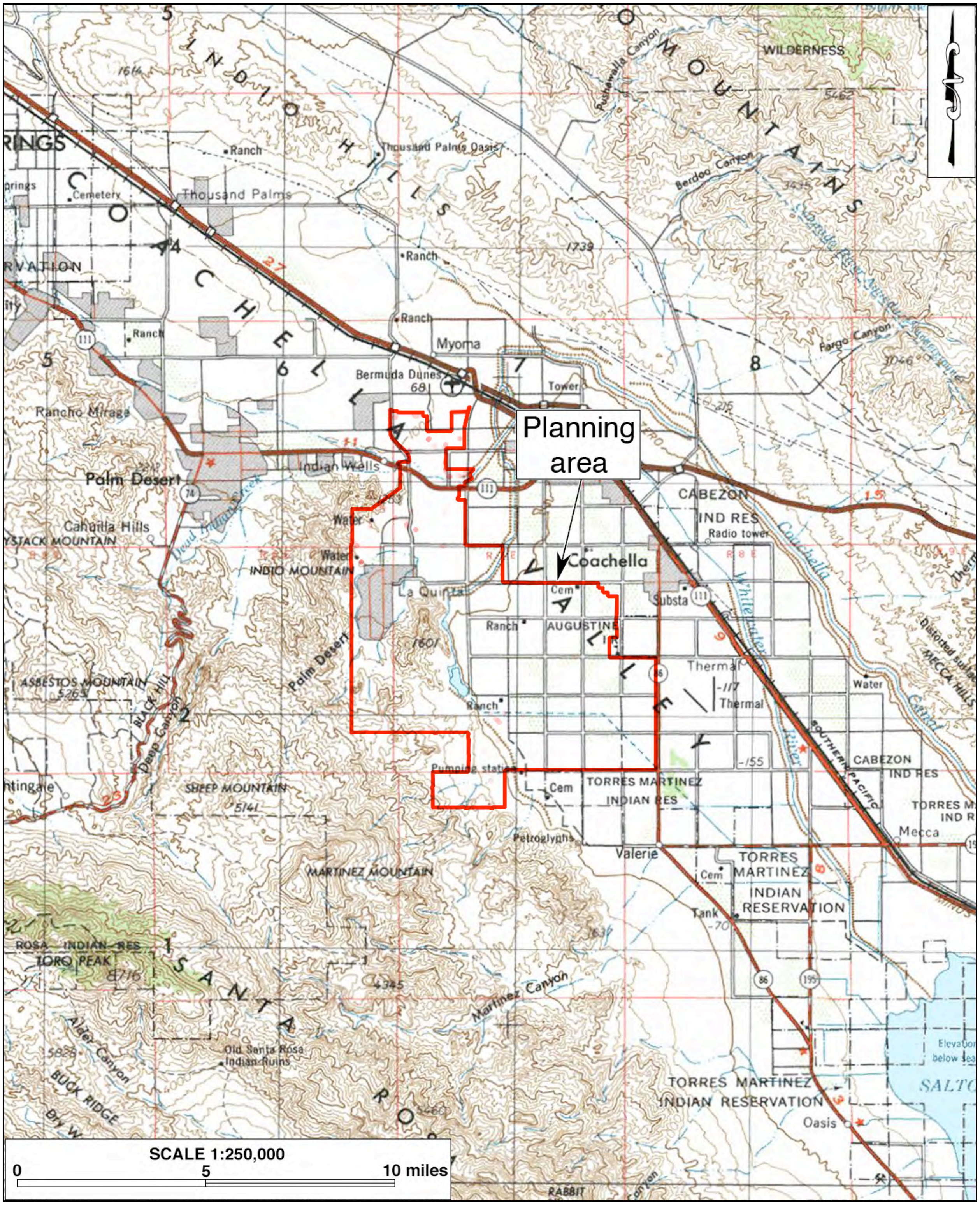

Figure 1. Project vicinity. (Based on USGS Santa Ana, Calif., 1:250,000 quadrangle)

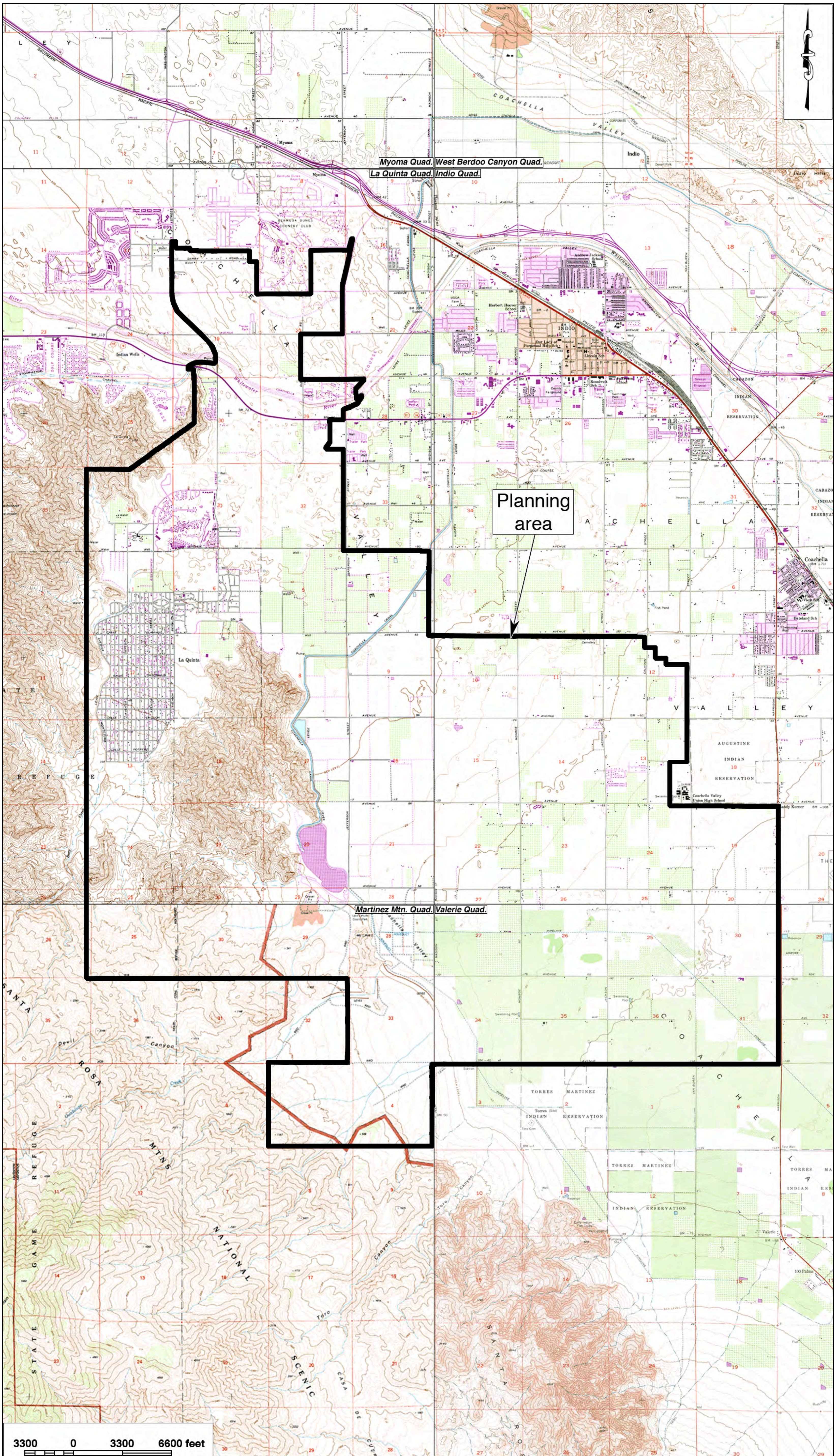

Figure 2. Planning area. (Based on USGS Indio, Valerie, La Quinta, and Martinez Mountain, Calif., 1:24,000 quadrangles)

plants, animals, and environments, and the chronology of the earth's history (Bates and Jackson 1980:451).

- Paleontologic species: A morphologic species based on fossil specimens. It may include specimens that would be considered specifically distinct if living individuals could be observed (Bates and Jackson 1980:451).
- Paleontologic resource: A locality containing vertebrate, invertebrate, or plant fossils (i.e., fossil location, fossil bearing formation or a formation with the potential to bear fossils).

GEOLOGIC SETTING

The planning area is located in the Coachella Valley, which occupies the northwestern portion of the Colorado Desert geomorphic province (Jenkins 1980:40-41). The Colorado Desert province is bounded by the Peninsular Ranges province on the southwest, the eastern Transverse Ranges province on the north, and the southern portion of the Mojave Desert province on the northeast (*ibid*.). It widens to the southeast as it extends through the Imperial Valley and into Mexico.

One of the major features found within the Colorado Desert province is the Salton Trough, a 290-kilometer-long (approx. 180 miles) structural depression containing the present-day Salton Sea and ancient Lake Cahuilla (McKibben 1993). The Salton Trough extends from the San Gorgonio Pass area southward into Mexico and, during the late Miocene and early Pliocene, constituted a northward extension of the Gulf of California (Powell 1995). Since elevations within the Colorado Desert province tend to be low while those of the adjacent mountainous provinces can be quite high, the northwestern portion of the Salton Trough was filled with more than 4,000 feet of mostly coarse, fluvial-derived, clastic sediments by late Pleistocene and Holocene times (Proctor 1968). While these types of sediments generally are not conducive for the preservation of vertebrate remains, some scattered vertebrate fossils have been found in them.

While the term "Salton Trough" refers to the entire structural depression from the San Gorgonio Pass to the Gulf of California, "Salton Basin" is used to describe the portion of the area that drains directly into the Salton Sea (Harms 1996:117). The Salton Sea, therefore, occupies the Salton Basin portion of the Salton Trough (*ibid*.). Ancient Lake Cahuilla, a name given to a series of freshwater lakes that once filled portions of the Salton Trough, including parts of the Coachella Valley, occupied a much larger portion of the Salton Basin than the present-day Salton Sea (Rogers 1965). The shoreline of the last ancient lake can be seen today as a line along the base of the Santa Rosa Mountains at an elevation of approximately 42 feet above mean sea level (Waters 1983; Wilke 1978). However, there were a number of earlier in-fillings of the Salton Trough, each leaving behind lacustrine sediment deposits. When the lake was dry or drying, fluvial and/or aeolian sediments were deposited in the same area. Much, but not all, of the planning area lies below the former shoreline of ancient Lake Cahuilla, since surface elevations within the project area range approximately from 1500 feet above mean sea level to some 130 feet below.

Approximately 4.5-5 million years ago, the Salton Trough was a northward extension of the Gulf of California. At that time, the gulf extended as far north as the Painted Hills area, just northeast of where the Whitewater River intersects Interstate 10 today. Sediments containing marine fossils that were deposited during this time can be found outcropping at the Painted Hills, the Garnet Hill, and at least two places in the Indio Hills. Eventually, the Salton Trough was cut off from the Gulf of California by the delta built up at the mouth of the Colorado River. This delta contains sediments that eroded from the Grand Canyon and extends across the gulf from the east to the west, subsequently creating a barrier between the gulf and the trough. While much of the Salton Trough is below sea level, the delta prevents any gulf waters from reaching the trough. Conversely, the delta prevents any water in the trough from flowing to the gulf except when the trough is full and the water can flow south over the delta.

The delta determined the direction of flow for the Colorado River. When the flow was diverted to the north of the delta it went into the Salton Basin and would fill the Trough until it reached the spill point. Once the spill point was reached, the water forming an ancient Lake Cahuilla would flow south over the western portion of the delta, through Baja California, and into the Gulf of California.

When the flow switched to the south, the Colorado River would head directly to the gulf, leaving the waters in the Salton Basin to evaporate slowly. The evaporation of the waters would leave behind a salt-encrusted basin at the lowest point. As floods occurred on the Colorado River, the flow of water switched directions many times, leading to the development of several lakes filling the Salton Basin during Holocene times and probably many more lakes that partially filled the basin (Laylander 1995; 1997; Waters 1983; von Werlhof 2001). Waters (1983:383) found evidence of four major lake fillings between circa A.D. 700 and 1500.

These high lake stands filled the basin for different lengths of time (Waters 1983:383). The last lake to fill the Salton Basin was originally thought to have dried up in the late 1500s (*ibid.*; Wilke 1978). However, more recent findings indicate that another lake filled the basin after this date. Moratto et al. (2007:Table 5-1) suggests that the lakes probably existed in the basin from around 895 B.C. to as late as A.D. 1740.

Freshwater shells from this last lake can be found today on the surface in many parts of the planning area. They can also be found below the surface, and some of these may be the result of previous in-fillings of the lake. Although all of these lakes owed their existence to water entering from the Colorado River, they occurred at different times and lasted for different lengths of time. Thus, changes in the lake faunas may be used to differentiate one lake stand from another.

LEGAL FRAMEWORK

Over the past decades, numerous pertinent federal, state, and local statutes, regulations, and guidelines have been established to mandate the protection of paleontologic resources, as summarized below.

Federal Laws and Regulations

A number of federal statutes specifically address paleontologic resources. They generally become applicable to a project if the project involves federal license, permit, approval, funding, or lands.

Antiquities Act of 1906 (16 United States Code [USC] 431-433) The Antiquities Act of 1906 states, in part:

> That any person who shall appropriate, excavate, injure or destroy any historic or prehistoric ruin or monument, or any object of antiquity, situated on lands owned or controlled by the Government of the United States, without the permission of the Secretary of the Department of the Government having jurisdiction over the lands on which said antiquities are situated, shall upon conviction, be fined in a sum of not more than five hundred dollars or be imprisoned for a period of not more than ninety days, or shall suffer both fine and imprisonment, in the discretion of the court.

Although there is no specific mention of natural or paleontologic resources in the Act itself, or in the Act's uniform rules and regulations (Title 43 Part 3, Code of Federal Regulations [43 CFR 3]), the statement "objects of antiquity" has been interpreted to include fossils by the National Park Service, the Bureau of Land Management, the United States Forest Service, and other federal agencies. Permits to collect fossils on lands administered by federal agencies are authorized under this Act. Therefore, projects involving federal lands will require permits for both paleontologic resource evaluation and mitigation efforts.

Archaeological and Paleontological Salvage (23 USC 305) Statute 23 USC 305 amends the Antiquities Act of 1906. Specifically, it states:

> Funds authorized to be appropriated to carry out this title to the extent approved as necessary, by the highway department of any State, may be used for archaeological and paleontological salvage in that state in compliance with the Act entitled "An Act for the Preservation of American Antiquities," approved June 8, 1906 (PL 59-209; 16 USC 431-433), and State laws where applicable.

This statute is seen as allowing funding for the mitigation of impacts to paleontologic resources that are encountered during federal projects, provided that "excavated objects and information are to be used for public purposes without private gain to any individual or organization" (*Federal Register* 46(19):9570).

National Registry of Natural Landmarks (16 USC 461-467) The National Natural Landmarks (NNL) program was established in 1962 and is administered under the Historic Sites Act of 1935. Implementing regulations were first published in 1980 under 36 CFR 1212 and the program was re-designated as 36 CFR 62 in 1981. A NNL is defined as:

> …an area designated by the Secretary of the Interior as being of national significance to the United States because it is an outstanding example(s) of major biological and geological features found within the boundaries of the United States or its Territories or on the Outer Continental Shelf. (36 CFR 62.2)

In the same section, the criteria for "national significance" is outlined as follows:

> …an area that is one of the best examples of a biological community or geological feature within a natural region of the United States, including terrestrial communities, landforms, geological features and processes, habitats of native plant and animal species, or fossil evidence of the development of life. (36 CFR 62.2)

Federal agencies and their agents should consider the existence and location of designated NNLs, and of areas found to meet the criteria for national significance, in assessing the effects of their activities on the environment under section 102(2)(c) of the National Environmental Policy Act (42 USC 4321). The National Park Service is responsible for providing requested information about the NNL Program for these assessments (36 CFR 62.6(f)). However, other than consideration under NEPA, NNLs are afforded no special protection. Furthermore, there is no requirement to evaluate a paleontologic resource for designation as an NNL. Finally, state and local project proponents are not obligated to prepare an application for listing potential NNLs, should such a resource be encountered during project planning and development.

Federal-Aid Highway Act of 1956 (20 USC 78) Section 305 of the Federal-Aid Highway Act of 1956 (20 USC 78, 78a) gives authority to use federal funds to salvage archaeological and paleontologic sites affected by highway projects.

National Historic Preservation Act of 1966 (NHPA; 16 USC 470) Section 106 of the NHPA does not apply to paleontologic resources unless the paleontologic specimens are found in culturally related contexts (e.g., fossil shell included as a mortuary offering in a burial or a petrified wood locale used as a chipped-stone quarry). In such instances the materials are considered cultural resources and are treated in the manner prescribed for the site in question, mitigation being almost exclusively limited to sites listed in or determined eligible for the National Register of Historic Places.

Section 4(f) of the Department of Transportation Act of 1966 (23 USC 138; 49 USC 1653) Section 4(f) of the Department of Transportation Act does not specifically address paleontologic resources. However, this section of the law places restrictions on the ability to take publicly owned 4(f) properties (which include parks, recreation areas, wildlife or waterfowl refuges, and properties listed in or eligible for the National Register of Historic Places). Paleontologic resources need to be addressed under this law only if they are located within a 4(f) property.

National Environmental Policy Act of 1969 (42 USC 4321) NEPA directs federal agencies to use all practicable means to "preserve important historic, cultural, and natural aspects of our national heritage" (Section 101(b)(4)). Regulations for implementing the procedural provisions of NEPA are found in 40 CFR 1500-1508.

If the presence of a significant environmental resource is identified during the initial stages of a project, federal agencies and their agents must take the resource into consideration when evaluating project effects. Consideration of paleontologic resources may be required under NEPA when a project is proposed on land under federal jurisdiction. The level of consideration may depend upon the federal agency involved.

State Laws and Regulations

The following state laws and regulations are applicable, or potentially applicable, to locally sponsored projects.

California Environmental Quality Act CEQA (Chapter 1, Section 21002) states, in part:

> It is the policy of the state that public agencies should not approve projects as proposed if there are feasible alternatives or feasible mitigation measures available which would substantially lessen the significant environmental effects of such projects, and that the procedures required are intended to assist public agencies in systematically identifying both the significant effects of proposed projects and the feasible alternatives or feasible mitigation measures which will avoid or substantially lessen such significant effects.

CEQA Guidelines (Article 1, Section 15002(a)(3)) state that CEQA is intended to:

> Prevent significant, avoidable damage to the environment by requiring changes in projects through the use of alternatives or mitigation measures when the governmental agency finds the changes to be feasible.

If paleontologic resources are identified during initial project studies as being within the proposed project area, the sponsoring, or lead, agency must take those resources into consideration when evaluating project effects. The level of consideration may vary with the importance of the resource.

CEQA Guidelines Section 15064.5 may provide protection for paleontologic resources. While this section deals specifically with historical resources, the guidelines define historical resources broadly to include any object, site, area or place that a lead agency determines to be historically significant. The regulation further provides that generally, a resource shall be considered "historically significant" if it has yielded or may be likely to yield information important in prehistory. Paleontologic resources fall within this broad category and, additionally, are included in the CEQA checklist under "Cultural Resources."

Ultimately, CEQA Guidelines (Title 14, California Code of Regulation [CCR], App. G, Sec. V(c)) require that public agencies in the State of California determine whether a proposed project would "directly or indirectly destroy a unique paleontologic resource" during the environmental review process.

California Public Resources Code (PRC) Section 5097.5 This section of the PRC states:

> No person shall knowingly and willfully excavate upon, or remove, destroy, injure or deface any historic or prehistoric ruins, burial grounds, archaeological or vertebrate paleontological site, including fossilized footprints, inscriptions made by human agency, or any other archaeological, paleontological or historical feature, situated on public lands, except with the express permission of the public agency having jurisdiction over such lands. Violation of this section is a misdemeanor.

Public lands are defined to include lands owned by or otherwise under the jurisdiction of the State of California or any city, county, district, authority, or public corporation, or any agency thereof. As stated above, this provision defines any unauthorized disturbance or removal of paleontologic, archaeological and/or historical materials for sites located on public lands as a misdemeanor.

PRC Section 30244 This section requires reasonable mitigation of adverse impacts to paleontologic resources for development on public lands.

California Code of Regulations Two other sections of CCR (Title 14, Division 3, Chapter 1), applicable to lands administered by the Department of Parks and Recreation, address paleontologic resources. These include:

- Section 4307, Geological Features: No person shall destroy, disturb, mutilate, or remove earth, sand, gravel, oil, minerals, rocks, paleontological features, or features of caves.
- Section 4309, Special Permits: The Department may grant a permit to remove, treat, disturb, or destroy plants or animals or geological, historical, archaeological or paleontological materials; and any person who has been properly granted such a permit shall to that extent not be liable for prosecution for violating the forgoing.

Local Laws and Regulations

The City of La Quinta's Historic Preservation Ordinance (Title 7, La Quinta Municipal Code [LQMC]) establishes a historic resources inventory as the official local register of properties that warrant proper protection under CEQA provisions. According to Criterion D for the inventory, a property may be considered for inclusion in the register if "it is an archaeological, paleontological, botanical, geological, topographical, ecological or geographical site which has the potential of yielding information of scientific value" (LQMC Section 7.06.020). A paleontologic locality thus listed in the historic resources inventory qualifies as a "historical resource" for CEQA-compliance purposes (PRC Section 5020.1(k); Title 14 CCR Section 15064.5(a)(1)-(3)).

Additional Resources

In addition to the regulations listed above, the Society for Vertebrate Paleontology also provides guidelines for identifying and protecting paleontologic resources (Society of Vertebrate Paleontology 1995).

INTERPRETING PALEONTOLOGIC SENSITIVITY

BASIS FOR SENSITIVITY ASSESSMENT

As defined above, paleontologic resources are the fossilized evidence of past life found in the geologic record, and include the localities where fossils were collected as well as the sedimentary formations in which they were found. Usually, the defining character of fossils or fossil deposits is their geologic age, which is typically older than 10,000 years, the generally accepted temporal boundary marking the end of the last late Pleistocene glaciation and the beginning of the current Holocene epoch. Despite the tremendous volume of sedimentary rock deposits preserved worldwide, and the enormous number of organisms that have lived through time, preservation of plant or animal remains as fossils is an extremely rare occurrence.

The preservation of organic remains requires a particular sequence of events involving physical and biological factors. Skeletal tissue with a high percentage of mineral matter is the most readily preserved within the fossil record; soft tissues not intimately connected with the skeletal parts, in contrast, are the least likely to be preserved (Raup and Stanley 1978). For this reason, the fossil record contains a biased selection not only of the types of organisms but also of the various parts of the organisms themselves. As a consequence, paleontologists are unable to know with certainty the quantity of fossils or the quality of their preservation that might be present within any given geologic unit at any given location.

A geologic formation is defined as a stratigraphic unit identified by its lithic characteristics (e.g., grain size, texture, color, and mineral content) and stratigraphic position. There is a direct relationship between fossils and the geologic formations within which they are enclosed, and with sufficient knowledge of the geology and stratigraphy of a particular area, it is possible for paleontologists to reasonably determine its potential to contain significant nonrenewable vertebrate, invertebrate, marine, or plant fossil remains. The paleontologic sensitivity for a geologic formation is determined by the potential for that formation to produce significant nonrenewable fossils. This determination is based on what fossil resources the particular geologic formation has produced in the past at other nearby locations.

In light of the infrequency of fossil preservation, fossils—particularly vertebrate fossils—are considered to be nonrenewable resources. Because of their rarity, and because of the scientific information they can provide, fossils are highly significant records of ancient life. They can provide information about the interrelationships of living organisms, their ancestry, their development and change through time, and their former distribution. Progressive morphologic changes observed in fossil lineages may provide critical information on the evolutionary process itself—that is, the ways in which new species arise and adapt to changing environmental circumstances. Fossils can also serve as important guides to the ages of the rocks and sediments in which they are contained, and may prove useful in determining the temporal relationships of rock deposits from one area to another and the timing of geologic events. Time scales established by fossils provide chronologic frameworks for geologic studies of all kinds. Additionally, fossils can also provide information regarding past climatic conditions and ecological zones.

Fossil resources generally occur in areas of sedimentary rock (e.g., sandstone, siltstone, mudstone, claystone, and shale) or fluvial sands, mud, and silt. Occasionally fossils may be exposed at the surface through the process of natural erosion or as a result of human disturbances; however, they generally lay buried beneath the surficial soils. Thus, the absence of fossils on the surface does not preclude the possibility of them being present in subsurface deposits, while the presence of fossils at the surface is often a good indication that more remains may be found in the subsurface. Common fossil remains include marine shells; the bones and teeth of fish, reptiles, and mammals; leaf assemblages; and petrified wood. Fossil traces, another type of paleontologic resource, include internal and external molds (impressions) and casts created by these organisms.

DETERMINATION OF SENSITIVITY

Sedimentary units that are paleontologically sensitive are those with a high potential for significant paleontologic resources—that is, rock units within which significant vertebrate or invertebrate fossils have been determined by previous studies to be present or likely to be present. These units include, but are not limited to, sedimentary formations that contain significant paleontologic resources anywhere within their geographical extent, as well as sedimentary rock units temporally or lithologically suitable for the preservation of fossils.

Determinations of paleontologic sensitivity must therefore consider not only the potential for yielding abundant vertebrate fossils but also the potential for production of a few significant fossils, large or small, vertebrate or invertebrate, that may provide new and significant taxonomic, phylogenetic, and/or stratigraphic data. Areas that may contain datable organic remains older than Recent and areas that may contain unique new vertebrate deposits, traces, and/or trackways must also be considered paleontologically sensitive.

Invertebrate Fossils

Generally, invertebrate fossils recovered from aquatic (marine or lacustrine) sediments are often widely distributed throughout a given outcrop or formation, are found in predictable locations, and are both abundant and well preserved. In fact, many invertebrate fossils—particularly aquatic invertebrate fossils—can sometimes number in the millions, and can be exposed over miles of outcrop. Some invertebrate fossils are so prolific that they constitute major rock material, such as chalk or diatomite.

Given these general observations, it is clear that sedimentary exposures containing abundant, well-preserved, and extensively distributed invertebrate fossils—but lacking vertebrate fossils—are less paleontologically sensitive than limited exposures containing only a few fossils from a restricted depositional zone, e.g., a narrow near-shore environment or a restricted, ephemeral inland lacustrine environment. In the first case, paleontologically significant data lost to adverse impacts (natural or man-made) could very likely be easily recovered from any other exposures of the impacted formation that contained similar fossil density and species diversity. In the second instance—that of the limited exposures from restricted depositional environments—adverse impacts to paleontologic resources might not be ameliorated by fossil salvage elsewhere in the formation, since the fossil abundance and species representation could likely be very different somewhere else. In this second case, the sediments under consideration would be determined to have a higher paleontologic sensitivity.

Vertebrate Fossils

Vertebrate fossils—fossils representing animals with backbones, including mammals, birds, reptiles, amphibians, and fish—are much rarer than invertebrate fossils and are often more poorly preserved. In marine rock units, significant vertebrate fossils are generally much less common than invertebrate fossils. Paleontologic resource localities yielding vertebrate fossils are also frequently recovered from terrestrial (non-marine) deposits; these continental deposits are generally less depositionally uniform than marine deposits, and fossilization is consequently even more infrequent. Further, in life, vertebrates are often far less abundant than invertebrates (for instance, the difference between a herd of hundreds or possibly thousands of bison versus marine or lacustrine beds containing hundreds of millions of bivalves); the infrequency of fossilization and the vicissitudes of the many taphonomic factors involved result in vertebrate fossils being extremely rare relative to their original numbers in life. For these reasons, vertebrate fossil resources are generally considered to have very high paleontologic significance and geologic formations that have the potential to yield vertebrate fossil remains are, therefore, considered to have the highest paleontologic sensitivity.

Taking the above into consideration, the Society of Vertebrate Paleontology (1995:22-27) issued a set of standard guidelines intended to assist paleontologists to assess and mitigate any adverse effects to nonrenewable paleontologic resources. The society defined three potential categories of paleontologic sensitivity for geologic units that might be impacted by a proposed project. These categories are described below, along with the criteria used to establish their sensitivity.

- **High sensitivity**: Rock (or geologic) units assigned to this category are considered to have a high potential for significant nonrenewable vertebrate, invertebrate, marine, or plant fossils. Sedimentary rock units in this category contain a relatively high density of recorded fossil localities, have produced fossil remains in the vicinity, and are very likely to yield additional fossil remains.
- **Low sensitivity**: Geologic units are assigned to this category when they have produced no or few recorded fossil localities and are not likely to yield any significant nonrenewable fossil remains.
- **Undetermined sensitivity**: Geologic units are assigned to this category when there is limited exposure of the rock units in the area and/or the rock units have been poorly studied.

As additional information becomes available, the assignment of paleontologic sensitivity for a particular geologic unit may change. In some parts of southern California, sedimentary exposures with few or no prior recorded fossils or fossil localities have recently proven abundantly fossiliferous during paleontologic mitigation activities for construction projects. For example, the Eastside Reservoir project site near Hemet, Riverside County, was originally determined to have "low to moderate" sensitivity, but subsequently has yielded thousands of well-preserved fossils of terrestrial Pleistocene epoch vertebrates (Springer and Scott 1994; Scott 1997; Springer et al. 1998; 1999).

SIGNIFICANCE OF PALEONTOLOGIC RESOURCES

As stated previously, preservation of plant or animal remains as fossils is an extremely rare occurrence. Because of the infrequency of fossil preservation, fossils are considered to be nonrenewable resources. They retain significant scientific interest if one or more of the following criteria apply (Scott and Springer 2003:6):

1. The fossils provide data on the evolutionary relationships and developmental trends among organisms, both living and extinct;
2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the time of geologic events therein;
3. The fossils provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas;
4. The fossils demonstrate unusual or spectacular circumstances in the history of life;
5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

As stated above, significant paleontologic resources are defined to be fossils or assemblages of fossils that are unique, unusual, rare, uncommon, diagnostically or stratigraphically important, or likely to add to an existing body of knowledge in specific areas—stratigraphically, taxonomically, or regionally—by providing relevant data for prominent research issues in the field. They can include fossil remains of large to very small aquatic and terrestrial vertebrates, remains of plants and animals previously not represented in certain portions of the stratigraphy, and fossils that might aid stratigraphic correlations, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, paleo-climatology, and the relationships of aquatic and terrestrial species.

Determinations of the significance of paleontologic resources can only be made by qualified, trained paleontologists familiar with the area and the fossils under consideration. Such determinations are best advanced in the light of a well-conceived and thoroughly defined paleontologic resource research design and management plan. With an efficient sampling plan based upon such a program, the ability of the paleontologists to recognize, recover, and preserve significant paleontologic resources is greatly enhanced.

The criteria advanced for interpretations of paleontologic resource significance constitute the foundation for any research design. Since a fossil is not generally considered to be significant unless it can provide pertinent, important information, any research program must be designed to reflect this fact. Research questions that do not incorporate one or more of the significance criteria should not be considered or included in the research design.

Given the limited number of paleontologically sensitive formations that might be impacted by in the planning area, a broad-based, initial research framework can be established to present questions of scientific interest that can be asked of any sizeable paleontologic assemblage from the area. Therefore, this general research design is provided as a basis of determining the significance of paleontologic resources by placing the recovered fossils and their associated contextual data in a pertinent research framework.

In association with the significance criteria listed above, several broad and basic categories for potential research issues are presented here as being of significant scientific interest, as well as being pertinent to the geologic and paleobiologic history of the fossil strata that could be affected during future development projects in La Quinta. These categories do not in and of themselves comprise a complete research framework; rather, they provide a starting point from which to address the significance of any fossil assemblage(s) identified within the planning area. These categories include:

- Faunal composition of the assemblage;
- Age(s) of the assemblage;
- Depositional environment of the sedimentary sequence;
- Taphonomic factors influencing the assemblage;
- Population structure/dynamics of individual species within the assemblage;
- Paleoenvironment of the region at the time(s) of deposition;
- Questions specific to individual species represented within the assemblage.

The guidelines for significance discussed above all have in common one basic assumption: that the fossils in question have been identified to a reasonably precise level, preferably to the generic or the specific level. All *identifiable* paleontologic resources are always potentially significant. In general, fossils are not considered to be significant unless they can be identified with some degree of precision. It is of course true that there are exceptions to this rule; unidentifiable bones or bone fragments, for example, can be of great significance when recovered from a sedimentary unit or formation that previously had not yielded fossils, or from an area with little or no history of paleontologic sensitivity. However, questions of evolutionary relationships, age of the deposit, and so forth—those questions that are generally employed to determine the significance of a paleontologic resource—cannot be reasonably addressed until the fossils under study have been identified to a relatively precise degree. Viewed in this light, unidentifiable fossils or fossil fragments can be seen as having limited scientific significance.

In the context of the planning process and development projects, detailed collection practices (i.e., academically driven research designs where every bone or bone fragment is analyzed) are not feasible. Destruction of at least some paleontologic resources is an unavoidable consequence of project-related earth-moving activities. Clearly, then, the goal of the paleontologist(s) in this context is not to eliminate impacts to fossil resources, but rather to mitigate such impacts by collecting and preserving a representative sample of the entire assemblage. In such cases, unidentifiable bones or bone fragments are not considered potentially significant in terms of the criteria presented above, since identification is usually an essential prerequisite to determining significance and there is little chance of ever supplementing these specimens with their missing portions or advancing more detailed identifications at some future date. Further, isolated fragments cannot be placed in a sufficiently detailed three-dimensional context with their missing portions to enable taphonomic data to be advanced with any reliability.

For these reasons, nondiagnostic bones or unidentifiable bone fragments of extinct animals identified within the planning area are determined to be scientifically significant only in a limited sense. In general, where exposed such elements will be employed by field researchers as indicating sediments or outcrops that demonstrably contain fossil resources. These areas will be examined and test-sampled to determine the presence or absence of more complete—and therefore more significant—paleontologic resources. Microfossils are an evident exception to this provision; these elements—generally not visible to the naked eye in the field—are obtained through recovery of bulk samples of fossiliferous sediments that are washed and processed in the laboratory. Some unidentifiable microfossil remains are an unavoidable circumstance of this collection procedure, although most fossils recovered in this manner are readily identifiable.

Regarding those fossil remains recovered in the planning area that are identifiable, it is important to reiterate that *all* identifiable paleontologic resources are always potentially significant. This being the case, the question of determining potential significance thus becomes one of where and when the identifications of the resource(s) are made—in the field before physical recovery of the resource, or in the laboratory subsequent to recovery and preparation. In some rare cases, accurate identifications of distinctive fossil elements to the genus or species level—and subsequent determinations of significance—are possible in the field. In most cases, however, accurate genus- or species-level identifications of megafaunal remains are not possible in the field for the following reasons: (1) The resources are generally not sufficiently well-exposed and visible to permit accurate field identification; (2) the resource(s) have generally suffered damage from equipment activity, which makes field identification(s) much more difficult; (3) many bones of comparably sized animals (for example, limb bones and vertebrae of camels and horses) are very similar in overall appearance, and are difficult to discriminate without the aid of a well-provisioned comparative osteological collection; and (4) in the context of a construction project that is proceeding according to a rigid schedule, precise identification in the field is neither efficient nor cost effective. Microfaunal remains offer an additional challenge, as these elements are generally not visible to the naked eye in the field; rather, they are recovered in the laboratory by processing of bulk samples of fossiliferous sediments.

Given the above, paleontologic field researchers should be, primarily, trained and responsible for the collection of resources that exhibit distinctive features such as articular surfaces, bony spines, or prominent bony ridges that will enable detailed identifications to be made later, in the laboratory. Resources that do not appear to be *potentially* diagnostic in this manner are generally not collected, although their presence in the field may be recorded in field notes.

Any of the fossil resources that appear, in the field, to be diagnostic are potentially significant in that they could provide data crucial to resolving any number of research questions under consideration both presently and in the future. Since this significance in most cases cannot be accurately (or cost-effectively) determined prior to recovery of the resource(s), it is most reasonable and efficient to recover all diagnostic or potentially diagnostic resources as they are exposed with the aim that these resources will, upon closer examination using various laboratory techniques, be later demonstrated to be scientifically significant.

The resolution of specific questions or issues outlined above can be attempted given certain volumes of certain types or kinds of fossil remains. However, while estimates of the sufficiency of data—that is, the number of specimens required to properly address a given question or issue—can be advanced *a priori*, such estimates should not be considered final. The acquisition of a quantity of specimens sufficient to address a given research question does not imply that no more specimens of a similar nature need to be collected. In most cases, the recovery of minimally sufficient numbers of specimens does not imply that "additional" remains are not significant; rather, estimates of sufficiency should be employed only to determine that it has become possible to begin to address a particular question. Nor can such estimates be treated in isolation, without also considering estimates of "sufficiency of data" necessary for the resolution of other paleontologic questions.

GEOLOGIC UNITS IN THE PLANNING AREA

Literature and map research, institutional records searches, and past paleontologic monitoring during construction-related earth-moving activities have resulted in the designation of various portions of the planning area as being high, low or undetermined in paleontologic sensitivity. The geologic characters of each area are discussed in this section in order to provide a context for understanding the types, nature, and scientific significance of the paleontologic resources that may be present.

A review of the pertinent literature and geologic mapping by Dibblee (1953; 2008), Jahns (1954), and Rogers (1965) indicates that five rock units crop out within the planning area. These rock units and their paleontologic sensitivity are summarized below, and their approximate locations are shown in Figure 3.

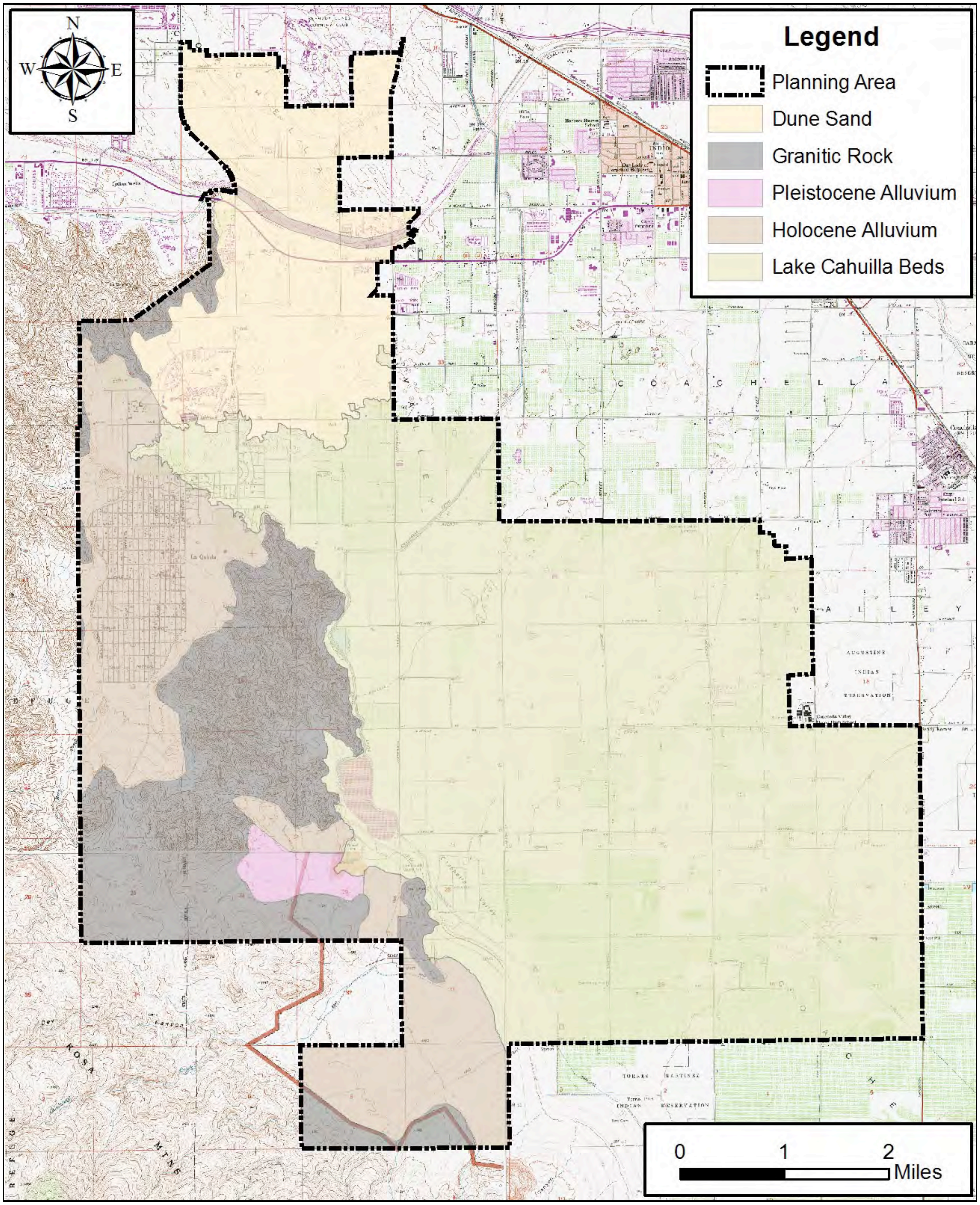

Figure 3. Geologic units within the planning area and their approximate boundaries.

MESOZOIC GRANITIC ROCKS

These are the granitic rocks exposed in the hills in the south-central and southwestern portions of the planning area (Fig. 3). They have a low potential to contain significant nonrenewable paleontologic resources.

PLEISTOCENE AND OLDER ALLUVIUM AND TERRACE DEPOSITS

Pockets of alluvial sediments in the southwestern portion of the planning area and downslope of the southern flanks of La Quinta Peak are mapped by Rogers (1965) as Pleistocene and older alluvium. However, these same sediments are mapped by Dibblee (2008) to be early Holocene in age. Lithologically similar sediments of Pleistocene age that occur at or near the surface throughout southern California have been documented to have high paleontologic sensitivity. Fossil faunas have been found to occur near the surface in Pleistocene sediments in Chino Hills, Rancho Cucamonga, Fontana, Riverside, and other areas in the northern margin of the Peninsular Range Province (Reynolds and Reynolds 1991).

At depths of 5-15 feet below the surface, Pleistocene fossils have been recovered from western San Bernardino County, near the Jurupa Mountains, as well as near Highway 71 in Chino. Pleistocene deposits in the Cajon Valley have also been suggested to contain fossil resources (Woodburne 1991). Fossils recovered from these areas included *Mammuthus* sp. (mammoth), *Paramylodon harlani* (sloth), *Camelops* sp. (camel), *Bison* sp. cf. *B. antiquus* (bison), *Equus* sp. (horse), and *Odocoileus* sp. (deer).

Recent work at the Eastside Reservoir project site near Hemet has yielded diverse and exceedingly well-preserved late-Pleistocene fauna from Pleistocene older alluvial sediments (Springer and Scott 1994; Pajak et al. 1996; Scott 1997; Springer et al. 1998; 1999). Taxa identified from this region include two kinds of ground sloth (*Megalonyx jeffersoni* and *Paramylodon harlani*), dire wolf (*Canis dirus*), sabre-toothed cat (*Smilodon fatalis*), extinct North American lion (*Panthera atrox*), American mastodon (*Mammut americanum*), Columbian mammoth (*Mammuthus columbi*), two species of horse (*Equus occidentalis* and *Equus conversidens*), peccary (*Platygonus compressus*), large camel (*Camelops hesternus*), and two species of bison (*Bison antiquus* and *Bison ?latifrons*). This fauna, too, has been found near the surface in alluvium similar to that mapped by Rogers (1965) in the La Quinta area.

In 1999, the San Bernardino County Museum, Section of Geological Sciences, reviewed the Regional Paleontologic Locality Inventory for what was the planning area of the La Quinta General Plan at that time. For this document, two new paleontologic resources records searches were conducted, one by the San Bernardino County Museum and the other by the Natural History Museum of Los Angeles County (Scott 2010; McLeod 2010; see App. 1). The results indicate that no paleontologic resources localities have been recorded from Pleistocene sediments within the planning area. However, one fossil locality has been recorded (SBCM 05.008.001) approximately three miles northeast of the northern limits of the planning area, along the southern margin of the Indio Hills.

That locality reportedly yielded fossil remains of an extinct camel from exposures of the Palm Springs Formation (Rymer 1990). Popenoe (1959:56-60) reportedly recovered the fossil remains of *Equus* sp. (horse) in the same general vacanity but did not assign it a fossil locality number. Additionally, Localities SBCM 05.009.001- 05,009.006 are recorded in the Mecca Hills several miles east of the southeastern portion of the planning area. Those localities yielded tusk fragments, bivalves, and animal trackways from the Palm Springs Formation.

A fossil skull of the extinct horse *Equus bautistensis* (or *Equus scotti*; see Scott 1998) recovered from the Palm Springs Formation in the Indio Hills suggests an early to middle-Pleistocene age for sediments in that region. The Palm Springs Formation is also highly fossiliferous within the boundaries of the Anza-Borrego Desert State Park, from which fossils of the extinct zebra-like horse *Equus enormis* (possibly also synonymous with, or at least closely related to, *Equus scotti*; see Scott 1998) have been described (Downs and Miller 1994; Scott 1998). This formation predates the Pleistocene older alluvium exposed in the planning area, and is not known to be present within the planning area.

The Palm Springs Formation is overlain by sediments of the informally named Ocotillo Formation in the Anza-Borrego region, which has yielded numerous fossils of extinct mammoths, mastodons, horses, camels and carnivores (Remeika 1992; Remeika and Jefferson 1995; Jefferson and Lindsay 2006). The Ocotillo Formation likely equates with Pleistocene older alluvial sediments mapped within the planning area; this inferred congruence reinforces the interpretation of high paleontologic sensitivity for these exposures in the La Quinta region. However, since no fossils have been found in what is mapped as Ocotillo Formation or Pleistocene alluvium in the Coachella Valley, any fossil finds would be very important.

LAKE CAHUILLA BEDS

Geologic mapping of the La Quinta region (Rogers 1965) indicates that much of the area is underlain by flat-lying lacustrine (lake) and fluvial (river) sedimentary strata. These strata were deposited below the high-stand shoreline of ancient Lake Cahuilla at the 42-foot contour line (Van de Kamp 1973). Lacustrine sediments have been deposited during each of at least seven high stands of Lake Cahuilla, and fluvial and dune sediments were laid down during the intervening lake low stands, when the lakebed was dry. These alternating lacustrine, fluvial, and dune sediments are referred to as the "Lake Cahuilla beds" (Fig. 3).

While the lakebed sediments are often called the Quaternary Lake Cahuilla beds (Rogers 1965; Dibblee 1954:Plate 3; Scott 2010), no Pleistocene-age fossils localities have been reported from these lakebed sediments or their equivalent strata in the Coachella Valley. A preliminary study of soil borings drilled for engineering purposes indicates that at least the upper 25 feet (approx. 7.5 meters) of sediments in the lower Coachella Valley are Holocene in age. A few borings have been drilled to 50 feet (approx. 15 meters) below grade without encountering any definable Pleistocene sediments. It is therefore doubtful that any Pleistocene fossils, vertebrate or invertebrate, will be recovered from the area containing lakebed sediments during normal construction operations.

Nonetheless, these lakebed sediments have yielded fossil remains representing a diversity of freshwater diatoms, land plants, sponges, ostracods, mollusks, fish, and small terrestrial vertebrates (Whistler et al. 1995; see App. 2). Deposits of tufa are also recorded from the shoreline of ancient Lake Cahuilla, along the rocks and hills west of Jefferson Avenue and in the Lake Cahuilla County Park area. Tufa is a carbonate coating on the rocks that indicates calcium carbonate deposition beneath the surface of a lake followed by a period of drying and/or aerial exposure. Thus, the presence of tufa along the shoreline of ancient Lake Cahuilla shows that these rocks were once located below the surface of a lake, as evidenced also by the green lacustrine clays, and subsequently exposed to the open air when the lake dried.

Studies of the Holocene history of Ancient Lake Cahuilla have resulted in discordant interpretations of the sequence of infilling and drying. Wilke (1978) generated radiocarbon (C-14) dates from archaeological specimens collected from the Lake Cahuilla beds to describe a sequence of flooding and drying in the region. This sequence was disputed by Waters (1983), who challenged Wilke's radiocarbon dates and obtained new dates of his own that were markedly different (Langenwalter 1990).

Given the limited number of dates generated by these two studies and the wide regional application of such pertinent data to advancing an understanding of the development and peopling of ancient Lake Cahuilla, it is clear that additional invertebrate and vertebrate fossils from the Lake Cahuilla beds would be critical to this endeavor. This highlights the scientific significance of the Lake Cahuilla fossils.

Paleontologic studies conducted during the construction of the PGA West Tom Weiskopf Signature Golf Course resulted in the identification of a succession of interbedded lacustrine and thinly bedded fluvial sediments (Whistler et al. 1995). Both of these lithologies were abundantly fossiliferous; the lacustrine units in particular yielded diverse small vertebrates including fish, lizards, snakes, birds, rabbits and rodents (App. 2). A single jaw of a bighorn sheep was also recovered in the area (McLeod 2010). Additionally, fossils of diatoms, ostracods and mollusks were recovered from the excavations.

Analysis of these fossils suggested that fresh water was present during the lacustrine intervals (Whistler et al. 1995). The fauna recovered included small-bodied species (App. 2) indicative of both sandy and rocky, brush-covered desert habitats. No vertebrates typical of wetter or aquatic habitats were recovered, which suggests that the flooding and desiccation episode of ancient Lake Cahuilla represented by these resources occurred rapidly since there was apparently insufficient time for wet-habitat taxa to migrate from the Colorado River to Lake Cahuilla before the lake evaporated (*ibid*.).

Although fossils recovered from the Lake Cahuilla beds are less than 10,000 years old, and are therefore, geologically speaking, relatively recent, they are scientifically significant in that they have the potential to provide valuable data on early ecological conditions and geomorphic development in the area, as demonstrated by Whistler et al. (1995). The value of these fossils to advancing current understanding of regional prehistory conforms with the CEQA guidelines regarding the determination of historical significance, which would then require mitigation of impacts to these types of resources since they have yielded, or may be likely to yield, important information. As a result, the Lake Cahuilla beds are determined to have high paleontologic sensitivity and to have the potential to contain nonrenewable paleontologic resources that could be subjected to adverse impacts from earth-moving activities.

The records search results indicate that six paleontologic localities have been recorded within the planning area, in exposures of the Lake Cahuilla beds. Two of these localities (LACMIP 16830 and 16831) are invertebrate localities; the remaining four localities (LACMVP 6252, 6253, 6255 and 6256) are vertebrate localities. These localities are purported to be in the south half of Section 21, T6S R7E, SBBM. Collectively these localities yielded the fish, lizards, snakes, birds, rabbits, rodents, diatoms, ostracods, and mollusks reported by Whistler et al. (1995; see App. 2).

The records search results further indicate that several paleontologic resource localities are present approximately four miles east of the northern portion of the planning area. These localities (SBCM 05.008.007-05.008.015) yielded fossil remains or freshwater bivalves and snails representing species that are still extant in the Colorado Desert of southeastern California and western Arizona (*ibid*.). These species presently occupy freshwater habitats with muddy to sandy substrates in relatively shallow (<2 m deep) but comparatively permanent bodies of water with rooted vegetation and debris. Two terrestrial vertebrate taxa were also found at these localities: *Thomomys* sp. (pocket gopher) and *Odocoileus* sp. (deer).

The presence of *Thomomys* is significant in that it suggests the presence of a wet or aquatic habitat, since pocket gophers prefer moist, warm substrates in which they can burrow (Nowak 1991). However, archaeological excavations in the La Quinta area have encountered active *Thomomys* sp. burrows in rather dry sands to depths of over 1 meter (3.28 feet) below the surface.

Previous studies of the Lake Cahuilla beds near La Quinta (Whistler et al. 1995) noted the absence of *Thomomys* from an otherwise abundant microfauna, and suggested that this absence, like the absence of amphibians, aquatic reptiles, waterfowl, and other small mammals preferring a moist substrate, indicates that Lake Cahuilla "was not a large persistent body of water" (*ibid*.:117). The recovery of *Thomomys* sp. from the Lake Cahuilla beds does not necessarily refute this contention, but does demonstrate that the recovery of additional fossils from these sediments may help further refine the understanding of the ancient lake.

The identification of a fossil vertebra of *Odocoileus* (deer) from the Lake Cahuilla beds is also of interest in that this taxon has not previously been reported from the fossil record of the region. This find is a significant addition to the fossil fauna of the region as it represents a previously unreported and extremely rare species. Once again, the importance of preserving fossil resources present below the surface in and around ancient Lake Cahuilla cannot be overemphasized.

HOLOCENE ALLUVIUM

Alluvial deposits of presumed to be Recent (Holocene) in age are present in the Cove area, along the western boundary of the planning area (Fig. 3), and lithologically similar alluvium has been observed southwest of the Lake Cahuilla County Park. These deposits consist of alluvium deposited during Holocene times as runoff from the nearby granitic hills, and are considered to be too young to be likely to contain significant nonrenewable paleontologic resources (McLeod 2010). However, it is possible that these recent, Holocene sediments overlie older alluvium of Pleistocene age that, if present at depth, would have a high potential to contain significant nonrenewable paleontologic resources (*ibid*.).

RECENT DUNE SAND

Sand dune deposits of Recent age are present in the northern portion of the planning area, generally north of Avenue 50 (Fig. 3). These dunes have resulted from the persistent high winds active in this area. The dune sands in the La Quinta area are too recent to contain significant nonrenewable paleontologic resources, and therefore have a low paleontologic sensitivity. However, as with the Recent alluvium described previously, it is possible for the Recent dune sands to overlie older alluvium of Pleistocene age and thus much higher paleontologic sensitivity. In a sewer line trench along Avenue 49 and west of Jefferson Street, the dune sands were found to interfinger with fluvial Whitewater River deltaic sediments and lacustrine sediments of the Lake Cahuilla beds at depths less than 20 feet (Quinn 1999:2-4).

RECOMMENDATIONS

The City of La Quinta has acknowledged the importance of paleontologic resources and has established the goal of preserving and protecting all such significant resources within the planning area. Based on the results of the literature and map review, the records search results from the San Bernardino County Museum and the Natural History Museum of Los Angeles County, and a review of various recent paleontologic studies in the area, several different zones have been delineated within the planning area according to geologic units and paleontologic sensitivity (Fig. 3). This section presents specific recommendations regarding the protection and preservation of paleontologic resources within the planning area.

GENERAL RECOMMENDATION

Because of the level of study in this document and the possibility of geologic formations to vary at any one specific area, the following recommendations are made:

1. For Lake Cahuilla beds or Pleistocene and older alluvium, as identified in Figure 3, an initial paleontological resource evaluation should be conducted in conjunction with entitlement processing. The initial paleontological study should consist of a paleontological records search at one or more facility that maintains records regarding the planning area (e.g., the Section of Geologic Sciences of the San Bernardino County Museum; the invertebrate and vertebrate Paleontology Sections of the Natural History Museum of Los Angeles County; the Anza-Borrego Desert State Park Paleontology Society; the Paleontology Museum at the University of California, Berkeley; the San Diego Natural History Museum, San Diego); a review pertinent geologic and paleontologic literature and maps; a field visit to verify the current condition of the subject property and to inspect the surface geologic formations. At the conclusion of these research endeavors a report detailing the findings, interpretations, conclusions, and recommendations based on the research results should be provided to the City.
2. For areas of granitic rock, dune sand or Holocene alluvium, as identified in Figure 3, an initial paleontological resource evaluation should be conducted in conjunction with the

site specific geotechnical analysis required for grading and building permits. The geotechnical borings should be analyzed by a qualified paleontologist to determine if the grading and/or building plans will impact Pleistocene or older soils. The initial paleontological study should consist of a paleontological records search; a review pertinent geologic and paleontologic literature and maps; a field visit to verify the current condition of the subject property and to inspect the geologic formations; and a thorough review of the soil borings. Should the analysis determine that such soils will be affected by the grading or construction of the site, the geologist should propose mitigation (monitoring or other means) which assure that paleontologic resources are properly identified and protected. At the conclusion of these research endeavors a report detailing the findings, interpretations, conclusions, and recommendations based on the research results should be provided to the City.

Regarding the various geologic deposits noted in the planning area, as determined by the initial paleontological resource evaluation noted above, the following guidelines may be applied during earth-moving activities.

MESOZOIC GRANITIC ROCKS

Age: Mesozoic
Sensitivity: Low
Recommendations: Prior to construction, an orientation meeting/workshop should be prepared by a qualified paleontologist to provide basic paleontologic training to the contractor, construction workers, and archaeological or other environmental monitors, possibly in conjunction with other preconstruction meetings. The workshop should focus on the nature, appearance, and importance of vertebrate, invertebrate, and plant fossils. It should be noted during the workshop that it is unlawful for construction personnel or anyone else other than the paleontologic monitor(s) to collect fossils from the project area during construction as these fossils belong to the public and should be placed in a recognized curation facility, such as a museum or university, where they will be treated, stored, maintained, and made available for scientific study.

Since the sensitivity of this type of geologic formation is low, full-time paleontologic monitoring may not be necessary, and the construction personnel would be responsible to note possible paleontologic resources or any changes in the geologic formation. They would then be required to stop work in that area and contact a qualified paleontologist to assess the find. Construction personnel should not collect any fossils found during earth-moving operations before their significance can be assessed by a qualified paleontologist.

If previously unmapped sediments that have high paleontologic sensitivity (e.g., Pleistocene older alluvium or Lake Cahuilla beds) are encountered, full-time paleontologic monitoring should then be required, with additional tasks implemented to preserve and protect potential paleontologic resources (see below).

PLEISTOCENE AND OLDER ALLUVIUM AND TERRACE DEPOSITS

Age: Pleistocene
Sensitivity: High

Description: Older alluvial sediments lithologically similar to sediments found throughout the Inland Empire that have previously yielded abundant late Pleistocene vertebrate fossils.

Recommendations: In areas of the older alluvial sediments, monitoring of earth-moving activities by a paleontologic monitor should be required. Prior to the commencement of the project, the paleontologist should develop a Paleontologic Resources Impact Mitigation Plan that will guide the fieldwork endeavors and establish criteria to determine if any paleontologic resources encountered are significant. Field monitoring should be initiated on a full-time basis, with the provision that—as warranted by field examination of sediments exposed—the field effort may be reduced to part-time monitoring or spot-checking where feasible as the project proceeds.

Sediments yielding remains of aquatic or terrestrial vertebrates should be screened in the field to determine the potential for the recovery of significant resources and the efficacy of more detailed sampling. Sediments yielding invertebrate remains would be screened in the field, and sampled only in those cases where significant data are likely to be obtained. Additionally, soil samples should be collected for processing through finer screens and inspected under magnification to determine if smaller fossils are present. The size of the soil sample will depend on the types of sediments being impacted and the recovery rates and type, and should be determined by the qualified paleontologist.

If significant fossils are recovered, they need to be properly documented, recovered, analyzed, and interpreted, and a final report detailing all of these procedures and presenting the findings needs to be produced. Additionally, all fossil remains recovered during construction and associated activities should be curated at the expense of the developer at a qualified research facility. A Memorandum of Agreement (MOA) for curation should be reviewed and approved among the developers, the City of La Quinta, the landowner (when applicable), and the curation facility providing rights to these materials for future research access. It should be noted that even previously disturbed or developed lands in areas of older alluvium are still considered highly sensitive for paleontologic resources, since future earth-moving activities could potentially impact subsurface fossil remains at previously undisturbed depths.

LAKE CAHUILLA BEDS

Age: Early Holocene
Sensitivity: High
Description: Lacustrine sediments that have yielded abundant fossils dating to the early Holocene Epoch.
Recommendations: See recommendations for "Older Alluvium," above. Note that areas of interbedding lacustrine and dune sands are less sensitive for paleontologic resources than areas of interbedding lacustrine and fluvial sediments.

HOLOCENE ALLUVIUM

Age: Recent
Sensitivity: Low
Description: Recent sediments that are too young to contain significant nonrenewable paleontologic resources.

Recommendations: See recommendations for "Granitic Rock," above.

RECENT DUNE SAND

Age: Recent
Sensitivity: Low
Description: Windblown dune sands that are too young to contain significant nonrenewable paleontologic resources.
Recommendations: See recommendations for "Granitic Rock," above.

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APPENDIX 1

PALEONTOLOGIC RECORDS SEARCH RESULTS

APPENDIX 2

COMPOSITE LIST OF FAUNA
RECOVERED FROM LAKE CAHUILLA BEDS

(Taxonomy According to Carroll 1988, Nowak 1991, and Whistler et al. 1995)

DIATOMS

Campylodiscus ?clypeus .... diatom
Cocconleis placentula .... diatom
Cyclotella ?kuetzingiana .... diatom
Epithemia argus .... diatom
Epithemia lurgida .... diatom
Hantzchia ?laenia .... diatom
Mastogloia elliptica .... diatom
Navicula clementis .... diatom
Navicula palpebralis .... diatom
Navicula ?ergadensis .... diatom
Nitzschia ?etcegoinia .... diatom
Nitzschia ?granulata .... diatom
Pinnularia viridis .... diatom
Rhopalodia gibba .... diatom
Surirello striatula .... diatom
Synedra ?ulna .... diatom
Terpsinoei musica .... diatom
Tetracyclus lacustris .... diatom

LAND PLANTS

Selaginella simuites .... club-moss
Polypodiacea .... fern
Pinus sp. .... pine
Betulaceae .... alder or birch
?Ceonothus sp. .... possible mountain lilac
Chenopodiaceae .... saltbush
Onagraceae .... evening primrose
Quercus sp. .... oak
Compositae .... ragweed and/or sunflower

PORIFERA .... sponges

MOLLUSCA .... mollusks

BIVALVES .... clams

Anodonta californiensis .... California floater
Anodonta dejecta .... floater clam
*Pisidium ?casertanum** .... pea clam
*Sphaerium striatum*** .... clam

GASTROPODS .... snails

*Amnicola longinqua**** .... dusky snail
Ferrisia ?walkeri .... cloche ancylid
Flumnicola sp.**** .... pebble snail
Gyraulus parvus .... ash gyro
Helisoma trivolvis .... rams horn
Physella ampullaceal .... paper physa
Physella concolor .... physa
Planorbella tenuis .... freshwater snail
Physella humerosa .... corkscrew physa

Tryonia protea .... desert tryonia
Fossaria sp. cf. *F. parva* .... freshwater snail
Acetocina anomala .... marine snail

* This has now been identified as *Pisidium compressum* by Patrick LaFollette.
** This may be a misidentification of *Corbicula fluminea*, an Asian clam found in the Coachella Canal water that is used to irrigate fields.
*** Now commonly referred to as *Fontelicella* (*Amnicola*) *longuinqua*
**** This may be *Flumnicola* sp. cf. *F. fucus*

CRUSTACEA .... crustaceans
OSTRACODA .... ostracodes
Cypridopsis vidua .... ostracode
Cyprinotus torosa .... ostracode
Limnocythere ceriotuberosa .... ostracode

OSTEICHTHYES .... bony fish
CYPRINIDAE .... minnows
?Cyprinodon macularius .... possible desert pupfish
Gila elegans .... bonytail chub
CATOSTOMIDAE .... suckers
X*yrauchen texanus* .... razorback sucker

AMPHIBIA .... amphibians
Rana pipiens .... leopard frog

REPTILIA .... reptiles
SQUAMATA
IGUANIDAE .... iguanid lizards
Phrynosoma platyrhinos .... desert horned lizard
Sceloporus magister .... desert spiny lizard
Uma inornata .... Coachella Valley fringe-toed lizard
Urosaurus graciosus .... long-tailed brush lizard
COLUBRIDAE .... colubrid snakes
Chionactis occipilalis .... western shovel-nosed snake
Hypsigiena torquata .... night snake
Piluophis melanoleucl;s .... gopher snake
Sonora semiannulata .... western ground snake
CROTALIDAE .... rattlesnakes
Crotalus cerastes .... sidewinder
Crotalus sp. (large) .... large rattlesnake

AVES .... birds
PASSERIFORMES .... advanced land birds
PELECANIFORMES .... pelicans, cormorants
Pelecanus crythrorhynchos .... white pelican
Phalacrocorax sp. .... cormorant

MAMMALIA .... mammals
LAGOMORPHA
LEPORIDAE .... rabbits
Sylvilgus sp. .... cottontailed rabbit

RODENTIA .... rodents
SCIURIDAE
Ammospermophilus leucurus ….. ...antelope ground squirrel
GEOMYIDAE
Thomomys sp. ....pocket gopher
HETEROMYIDAE
Perognathus longimembris .... pocket *mouse*
?Dipodomys sp. ....possible kangaroo rat
CRICETIDAE
Neotoma lepida .... desert wood rat
Peromyscus sp.. deer mouse
PERISSODACTYLA ....odd-toed hoofed mammals
EQUIDAE
?Equus sp. (small) .... possible extinct small horse
ARTIODACTYLA ....even-toed hoofed mammals
CERVIDAE
Odocoileus sp. ....deer
BOVIDAE
Ovis canadensis ....bighorn sheep